EDITED BY KRISTEN MUELLER AND JAKE YESTON

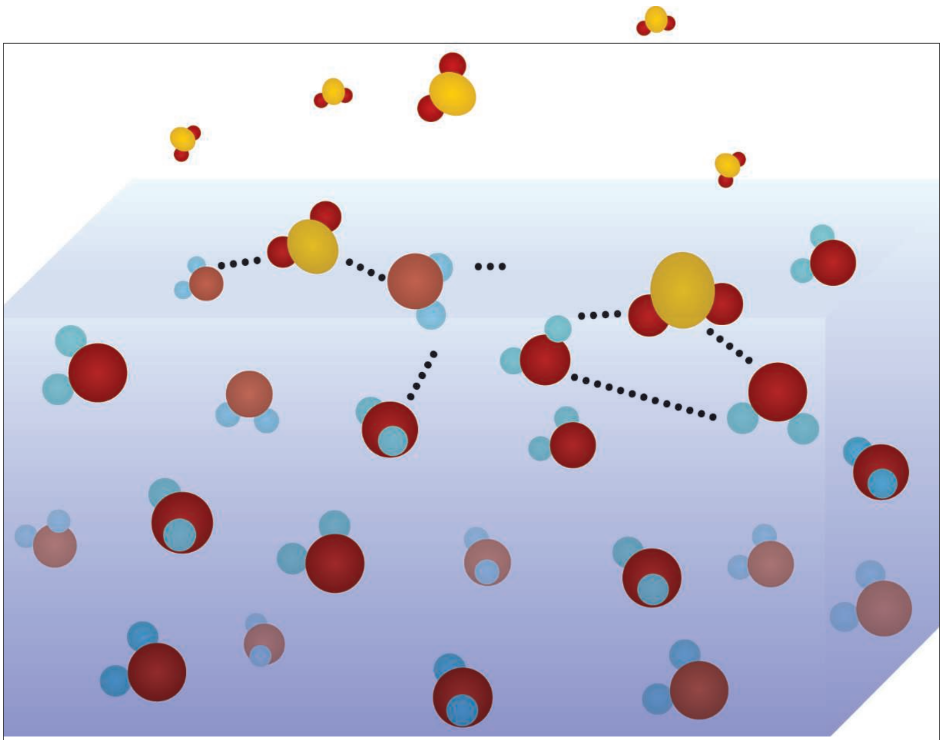
BIOMEDICINE

Multitasking Drugs

The escalating cost of developing new drugs has reinvigorated interest in "drug repositioning," the idea that a drug with a good track record for clinical safety and efficacy in treating one disease might have broader clinical applications, some of which would not easily be predicted from the drug's mechanism of action. This concept is illustrated by two recent studies that propose that drugs developed for cardiovascular disease might offer beneficial effects in the setting of prostate cancer.

Farwell *et al.* suggest that statins (cholesterol-lowering drugs) merit serious consideration as a possible preventive strategy for prostate cancer. Building on earlier work on this topic, they found in a study of medical files of over 55,000 men that those who had been prescribed statins were 31% less likely to be diagnosed with prostate cancer than those who had been prescribed another type of medication (antihypertensives). In independent work, Platz *et al*. screened for agents that inhibit the growth of prostate cancer cells and found that one of the most effective was digoxin, a drug used to treat heart failure and arrhythmia. A complementary epidemiological analysis of about 48,000 men revealed that digoxin use was associated with a 25% lower risk of prostate cancer, leading the authors to suggest that this drug be further studied as a possible therapeutic for the disease. — PAK

J. Natl. Cancer Inst. **103**, 1 (2011); *Cancer Discovery* **1**, OF66 (2011).



CHEMISTRY

Accumulating SO_2

Once in the atmosphere, SO_2 (a byproduct of coal combustion) can be oxidized further in the gas phase by radicals or undergo a more complex sequence of events within the aqueous phase of aerosol droplets, where (among other things) it may contribute to acid rain. The initial step in the latter process, the surface adsorption of SO_2, probably depends on temperature and droplet composition. Ota and Richmond used vibrational sum-frequency generation—a technique highly sensitive to surface phenomena—to look at the adsorption of SO_2 on water surfaces between the freezing point and room temperature. They found that at the coldest temperatures, almost all of the water molecules formed a surface complex with an adsorbed SO_2 molecule, unlike the much lower surface coverage near room temperature. They also found that changing pH had little effect on adsorption, demarcating a clear division between the surface and internal chemistry of the droplets. — PDS

J. Am. Chem Soc. **133**, 10.1021/ja201027k (2011).

ECOLOGY

Community Shares

Climate change impacts are often assessed by tracking single species' responses. Species exist as part of larger biological communities, however, and environmental changes can influence how species interact and allocate resources. One approach for assessing community-level change is to look at "aggregate properties," the physical and energetic components of a community produced by the contribution and consumption of all its members. These include total abundance, biomass, and energy use. Community aggregate properties are typically thought to be more resistant to disturbance than are single species because of compensatory dynamics among community members.

According to Rowe *et al.*, however, these properties do indeed respond to persistent environmental changes, and such responses may be important indicators of the large-scale ecological impacts of climate change. The estimated total abundance, biomass, and energy use of a small mammal community, consisting of over 20 species, sampled 80 years ago in the Ruby Mountains of Utah, was compared to the same properties measured in the modern community. All properties showed marked declines and a shift in allocation away from diet and habitat specialists to generalists. These findings suggest that climate warming and increased variability in precipitation have reduced primary productivity, resulting in not only a decrease in small mammal biomass but also an increased prevalence of ecological generalists better able to respond to an idiosyncratic fluctuation in resources. — SNV

Ecology **92**, 10.1890/10-1634.1 (2011).

CHEMISTRY

Accumulating CO_2

Even a milliliter of water contains so many trillions upon trillions of molecules that a proton concentration range spanning 14 orders of magnitude (the standard pH scale) is rather easily sampled and measured. What happens, though, when water droplets shrink down to a few thousand molecules or less? At that point, it's hard to even define the pH range, let alone measure it. Levinger *et al.* confronted this dilemma in exploring the potential of CO_2 to penetrate and react within reverse micelles—nanometer-scale pools of water bounded by surfactants within a hydrophobic solvent. They relied on tracking the extent to which vanadium oxide ions dissolved in the

CREDIT (TOP TO BOTTOM): OTA AND RICHMOND, J. AM. CHEM SOC. 133, 10.1021/JA201027K (2011)

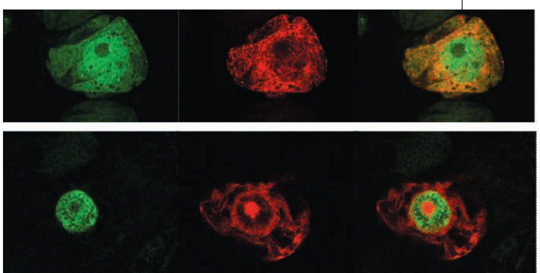
water pools linked up with one another after CO_2 was introduced (^{51}V nuclear magnetic resonance spectroscopy can clearly distinguish and quantify the different metal clusters). The known pH dependence of this oligomerization equilibrium in more conventional environments then allowed them to estimate the effective acidity within the micelles before and after CO_2 absorption. The results indicated significant absorption of CO_2 into the water pools, even under ambient conditions, with concomitant acidification presumably associated with carbonic acid formation. The study implies that analogous acidification of atmospheric aerosols by CO_2 may be a more important process than previously appreciated. — JSY

J. Am. Chem. Soc. **133**, 7205 (2011).

CELL BIOLOGY

Splicing Limits the Damage

When plants encounter stresses such as extreme heat and drought, they induce signaling systems to minimize potential damage. Yeast and mammalian cells also engage similar signaling cascades in response to stress. In plant, yeast, and mammalian cells, stress-induced cellular damage is induced by the accumulation of unfolded proteins in the endoplasmic reticulum (ER), and this drives the expression of genes that promote proper protein folding or sequestration of misfolded proteins. Proteolytic processing and splicing of transcription factor mRNA are major mechanisms of generating transcription factors capable of inducing stress-related genes. In plants, two members of the bZIP family of transcription factors are activated by proteolytic processing, but bZIP60, although truncated in its active form, is not activated in this manner. Deng *et al*. now show that in response to stress, mRNA that encodes the



CREDIT (TOP TO BOTTOM):DENG *ET AL.*, *PROC. NATL. ACAD. SCI. U.S.A.* 108, 7247 (2011)

transcription factor bZIP60 is spliced to exclude a transmembrane domain and to implement a putative nuclear targeting signal. After splicing and translation, the bZIP60 protein translocates to the nucleus (above; top row: unspliced bZIP60 (green) localized to the cytoplasm; bottom row: spliced bZIP60 localized to the nucleus), where it is able to activate downstream stress-response genes. These results show that stress-induced signaling mechanisms are highly conserved. — PJH

Proc. Natl. Acad. Sci. U.S.A. **108**, 7247 (2011).

MOLECULAR BIOLOGY

Precision RNA Measurements

Total RNA content within a cell depends on the rates of production of RNA transcripts, their processing, and the degradation of mature transcripts. Rabani *et al*. sought to determine how each of these processes contributes to the total RNA levels within a cell by using metabolic RNA labeling, RNA quantification, and computer modeling. Changes in RNA levels depended most on the rate of transcription; however, this was variable across genes. Degradation rates were also variable across genes, and alterations in degradation rates were important for achieving sharp peaks in RNA amounts. Furthermore, RNA processing rates also varied across genes. These studies comprehensively show that RNA amounts within the cells are determined by complex interactions between all three processes, whose rates may be linked to the biological functions of these transcripts. — LMZ

Nat. Biotechnol. **29**, 10.1038/nbt.1861 (2011).

GEOLOGY

When It's Cold Down South

Earth's climate cooled markedly over the past 65 million years, changing from a world with forests and dinosaurs near the poles to one with huge ice sheets in Antarctica and much lower sea levels. A marked decrease in atmospheric CO_2 levels probably drove this cooling; a further important change was that plate motions isolated Antarctica from the other continents. Temperature records have been available from the oceans and other continents, where a variety of biological records can be tapped, but not from Antarctica for comparison. Dallai and Burgess have now constructed an initial temperature record using hydrogen isotopes in minerals in Antarctic igneous rocks altered by hydrothermal fluids at specific dated times in the past. These fluids tap surface waters where the isotopic ratio in part reflects temperature, and hydrogen is regularly exchanged between fluids and OH-bearing minerals. The record, although rough and in some cases supported with limited data, shows cooling after about 40 to 45 million years ago by more than 10°C and a suggestion of some significant oscillations. — BH

Geology **39**, 423 (2011).

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